

hoff, Zöllner, Secchi, &c. Then at some length the circular refraction and anomalous dispersion theories by Schmidt and Julius respectively are discussed. The temperature of the sun comes next under review, followed by a chapter on the dynamic and thermal equilibrium of the sun. Lastly, the electromagnetic field of the sun and the theories concerning the corona are taken in hand, and the views of Schuster, Bigelow, Deslandres, Ebert, Nordmann, Arrhenius, &c., are contrasted. This chapter also includes an account of Hale's work on the magnetic field in sun-spots, and recent researches carried out at Meudon on the high level strata of the solar atmosphere.

The text is well illustrated with numerous reproductions from recent solar researches, and the volume contains good bibliographical author and subject indices.

(2) Prof. Pringsheim's book is the outcome of a set of lectures which extended over a series of years at the Berlin University. These lectures were not restricted to astronomical students only, so that the subject was dealt with in a little more popular manner than otherwise would probably have been the case.

The twelve lectures which form the subject of this volume comprise a comprehensive survey of the past and present views relative to the physics of the sun, and the author has managed to include a great deal of material in these lectures. The information has been brought well up to date, and the monochromatic work accomplished by the aid of the spectroheliograph in the hands of Deslandres and Hale has been thoroughly dealt with, and forms a valuable chapter. The volume is well illustrated, contains a great number of references, and is accompanied by useful subject and name indices. It will be found a serviceable book for students and a good readable volume for those who wish to become acquainted with the progress in our knowledge of the physics of the sun.

SOME ASPECTS OF PHYSICAL CHEMISTRY.

- (1) *The Elements. Speculations as to their Nature and Origin.* By Sir William A. Tilden, F.R.S. Pp. xi+139. (London and New York: Harper and Brothers, 1910.) Price 2s. 6d. net.
- (2) *The Relations between Chemical Constitution and Some Physical Properties.* (Text-Books of Physical Science. Edited by Sir William Ramsay.) By Prof. Samuel Smiles. Pp. xiv+583. (London: Longmans, Green and Co., 1910.) Price 14s.
- (3) *Physical Chemistry. Its Bearing on Biology and Medicine.* By Prof. James C. Philip. Pp. vii+312. (London: Edward Arnold, 1910.) Price 7s. 6d. net.

THE discovery of radio-activity has, by the introduction of a new idea, reawakened interest in many outstanding problems of physical science. Prominent among these is the fascinating question of the nature and origin of the elements. Chemists with the periodic table of Mendeléeff before them, in spite of the warnings of its author, have been unable to resist the idea that some close genetic

relation exists between the different elements of the nine groups of which the table consists, certainly along the vertical lines and probably also along the horizontal series. As to the nature of this relationship, nothing very definite was known or even imagined beyond the fact that it was accompanied by increase in atomic mass, and the probability that it was the result of condensation of some primal matter or protyle, under the influence of changing conditions, of which temperature was possibly one of the chief factors.

(1) The effect of recent work on the views entertained by chemists on this question forms the subject-matter of the latter portion of Sir William Tilden's book, the former half being devoted to a brief and clear exposition of the ideas which led to the formulation of the periodic law. The interesting account given of the various theories of the evolution and constitution of the elements which have recently been proposed culminates in a tentative and most suggestive genealogical table of the elements, which cannot fail to arrest the attention of all chemists. The author favours the idea that the elements of the seven chief vertical groups (with exception of the families headed by copper, chromium, and manganese) are directly "descended" from the seven elements from sodium to chlorine, the members of the odd and even series forming separate families with a common ancestor. The remaining elements (Group 8 and the exceptions just mentioned) are more or less directly descended from iron, which itself is placed in genetic relation with aluminium. The elements sodium to chlorine are direct descendants of the corresponding elements of lower atomic weight, lithium to fluorine, and these are themselves formed by the condensation of varying proportions of the two primal constituents of all matter, positive and negative protyle, as to the nature of which nothing is known. It is, moreover, by the addition of further amounts of these two primal substances that one element is derived from another of lower atomic weight.

Hydrogen is a progenitor of lithium, and a new unknown element, of atomic weight 3, is postulated as a precursor of fluorine. The elements of the zero-group (the helium gases) are supposed to be by-products of the disintegration of elements of high atomic weight, possibly long extinct. In this connection it may be noted that the radium emanation is stated to be wholly converted into helium, a conception at variance with the generally received idea.

Such a scheme, in the nature of things, teems with doubtful points, and the author is to be congratulated on his courage in exposing his ideas to the shafts of criticism which are sure to be winged against them. His table, however, undoubtedly expresses much that has been vaguely in the minds of many chemists, and removes some of the chief difficulties inherent in the classification of the elements in the strict order of their atomic weights. Where it appears to be deficient is in the expression of the relations between the members of the horizontal series. It must also be remembered that the only positive evidence of genetic relationship at present

available, which is afforded by the disintegration of the radio-active elements, seems to indicate that devolution occurs primarily along the horizontal series, and that the highest known member of the helium group—the newly-christened niton—takes its place in the chain of descent along with the other elements, and cannot be regarded simply as a by-product.

Enough has been said, however, to indicate the great interest attached to this short work, and the service rendered by the author in presenting in a collected form the ideas of chemists, enriched by his own suggestions, on this fundamental problem of the science.

(2) Dr. Smiles treats of a subject much more amenable to experiment than the disintegration of the elements, and the perusal of his bulky volume shows how difficult it is to arrive at any but empirical relations between physical properties and chemical constitution, even when the effect of every minute change in constitution can be examined experimentally. The work deals with the chief physical properties of the elements and their compounds (with certain exceptions which have already been considered in other volumes of the series), and provides an extremely useful compendium of the work which has been done in this connection. The author has, however, not allowed his subject, great as is the mass of detail comprised in it, to overwhelm him, but has throughout paid special attention to the applications which have been made of the knowledge acquired to the solution of problems of constitution, and to the effect of progress in this branch of the subject on the general trend of chemical theory. The interest is further increased by a preliminary clear account of the nature of each physical property in turn, and a historical sketch of the progress of knowledge with regard to it. The author's final conclusion that further advance will depend essentially on a more complete solution of the problem of valency will probably commend itself to most chemists, and there seems little doubt that, as foreshadowed in many parts of this book, the study of physical properties will be an important factor in the attainment of this result.

In his exposition of the general principles of physical chemistry (3), Dr. Philip has aimed at giving an account of the subject which will be of special value to workers in the borderland regions of biology and chemistry, and has therefore adapted his book both in scope and treatment to attain this end. Without any sacrifice of scientific accuracy, he has given a sound and readable account of the subjects of chief interest to biologists, and has illustrated them wherever possible by reference to problems of a biological nature. In addition to the ordinary fare of works on elementary physical chemistry, special attention is paid to osmosis, permeability and impermeability of membranes, the properties of colloids and adsorption. On the whole, the author has succeeded admirably in his purpose, and has provided a valuable and interesting introduction to the subject, not overburdened with detail and almost free from those mathematical subtleties which are too frequently the despair of biologists.

ARTHUR HARDEN.

CHEMISTRY FOR FIRST-YEAR STUDENTS.

(1) *A College Text-book of Chemistry.* By Prof. Ira Remsen. Second edition, revised. Pp. xxiii+702. (London: Macmillan and Co., Ltd., 1908.) Price 10s. net.

(2) *Outlines of Chemistry. A Text-book for College Students.* By Prof. Louis Kahlenberg. Pp. xix+548. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1909.) Price 11s. net.

(1) **T**HE first edition of Prof. Remsen's "College Chemistry" was somewhat unfavourably reviewed in these columns [*NATURE*, vol. lxx., p. 314 (1902)], and, unfortunately, most of the faults then pointed out recur in the present edition. Notable exceptions are, however, the treatment of the ionic hypothesis and of the determination of molecular weights from measurements of osmotic pressure. The least satisfactory portions of the work are those dealing with physical and electro-chemistry. Even on the purely chemical side there are some passages which might be amended. Thus it is not generally true, as stated on p. 144, that metals can be distinguished from non-metals according to whether they do or do not liberate hydrogen from hydrochloric acid to form chlorides. (A better criterion is, however, given on p. 169.) On pp. 185-6 volumetric analyses are calculated on the objectionable system based on a consideration of the weights of the reacting substances in the respective measured volumes, instead of by the straightforward "equivalent" method.

These faults are the more to be regretted since the book is in many ways admirably suited for the purpose for which it is intended. Thus Chapter V., dealing with the atomic theory and the determination of atomic and molecular weights, is, for the most part, a model of clearness. Attempts have been made to bring the work up to date by the insertion of short references to the phase rule, catalysis, the electron theory, radioactivity, &c. Within the scope allowed, the systematic descriptive portion is excellent. The experimental exercises given at the end of each chapter are well chosen; but, unfortunately, few first-year students in this country would have the time or the laboratory facilities for carrying them out.

(2) Prof. Kahlenberg's book is, like the preceding, intended for first-year students, and of necessity covers much the same ground; but there the resemblance ends. The general plan, as set forth in the preface, is to lead up to general theories through the fundamental facts and laws instead of first laying down general propositions and then illustrating these by facts. Accordingly, no mention of the atomic and molecular theories or of chemical nomenclature and symbols is made until the sixth chapter is reached.

Physical chemistry does not occupy a prominent place in the book; nevertheless, seeing that Prof. Kahlenberg is practically the only opponent of the generally accepted ionic hypothesis to be taken seriously, we turn with interest to the pages dealing with this part of the subject. On p. 429 we find the remark: "The main difference between the Clausius and Arrhenius theories is that the latter assumes the